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Life Cycle Assessment of Todays and Future Electricity Grid Mixes of EU27

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Abstract : At the United Nations Climate Change Conference 2015 a global agreement on the reduction of climate change was achieved stating CO_2 reduction targets for all countries. For instance, the EU targets a reduction of 40 percent in emissions by 2030 compared to 1990. In order to achieve this ambitious goal, the environmental performance of the different European electricity grid mixes is crucial. First, the electricity directly needed for everyone's daily life (e.g. heating, plug load, mobility) and therefore a reduction of the environmental impacts of the electricity grid mix reduces the overall environmental impacts of a country. Secondly, the manufacturing of every product depends on electricity. Thereby a reduction of the environmental impacts of the electricity mix results in a further decrease of environmental impacts of every product. As a result, the implementation of the two-degree goal highly depends on the decarbonization of the European electricity mixes. Currently the production of electricity in the EU27 is based on fossil fuels and therefore bears a high GWP impact per kWh. Due to the importance of the environmental impacts of the electricity mix, not only today but also in future, within the European research projects, CommONEnergy and Senskin, time-dynamic Life Cycle Assessment models for all EU27 countries were set up. As a methodology, a combination of scenario modeling and life cycle assessment according to ISO14040 and ISO14044 was conducted. Based on EU27 trends regarding energy, transport, and buildings, the different national electricity mixes were investigated taking into account future changes such as amount of electricity generated in the country, change in electricity carriers, COP of the power plants and distribution losses, imports and exports. As results, time-dynamic environmental profiles for the electricity mixes of each country and for Europe overall were set up. Thereby for each European country, the decarbonization strategies of the electricity mix are critically investigated in order to identify decisions, that can lead to negative environmental effects, for instance on the reduction of the global warming of the electricity mix. For example, the withdrawal of the nuclear energy program in Germany and at the same time compensation of the missing energy by non-renewable energy carriers like lignite and natural gas is resulting in an increase in global warming potential of electricity grid mix. Just after two years this increase countervailed by the higher share of renewable energy carriers such as wind power and photovoltaic. Finally, as an outlook a first qualitative picture is provided, illustrating from environmental perspective, which country has the highest potential for low-carbon electricity production and therefore how investments in a connected European electricity grid could decrease the environmental impacts of the electricity mix in Europe.

Keywords : electricity grid mixes, EU27 countries, environmental impacts, future trends, life cycle assessment, scenario analysis

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